

RENEWABLE INTEGRATION IN THE NEM

May 2014

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SYSTEMS CAPABILITY



AEMO – ELECTRICITY ROLES



Market Operator

- ~\$10B spot market

National Planner

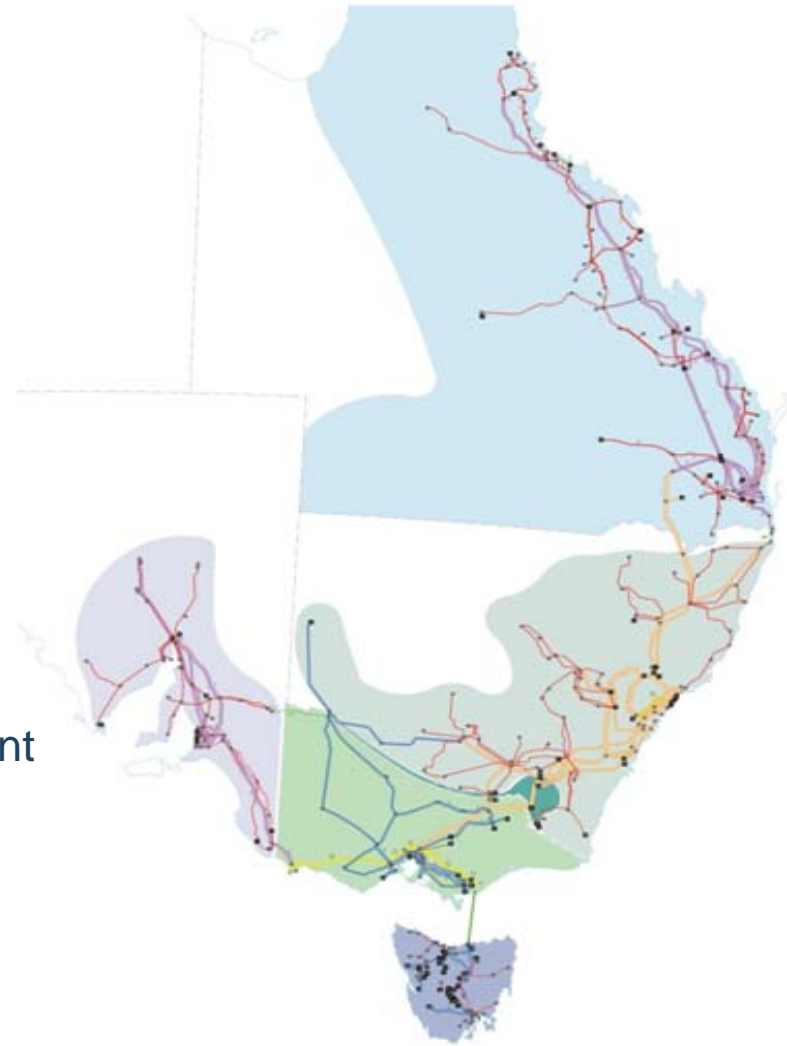
- Demand forecasts (NEFR)
- Network planning (NTNDP)
- Generation capacity requirements

Power System Operator

- Real-time dispatch of generation
- Power system security
- Connection of new generation

Market development, Emergency management

Significant roles in Gas.

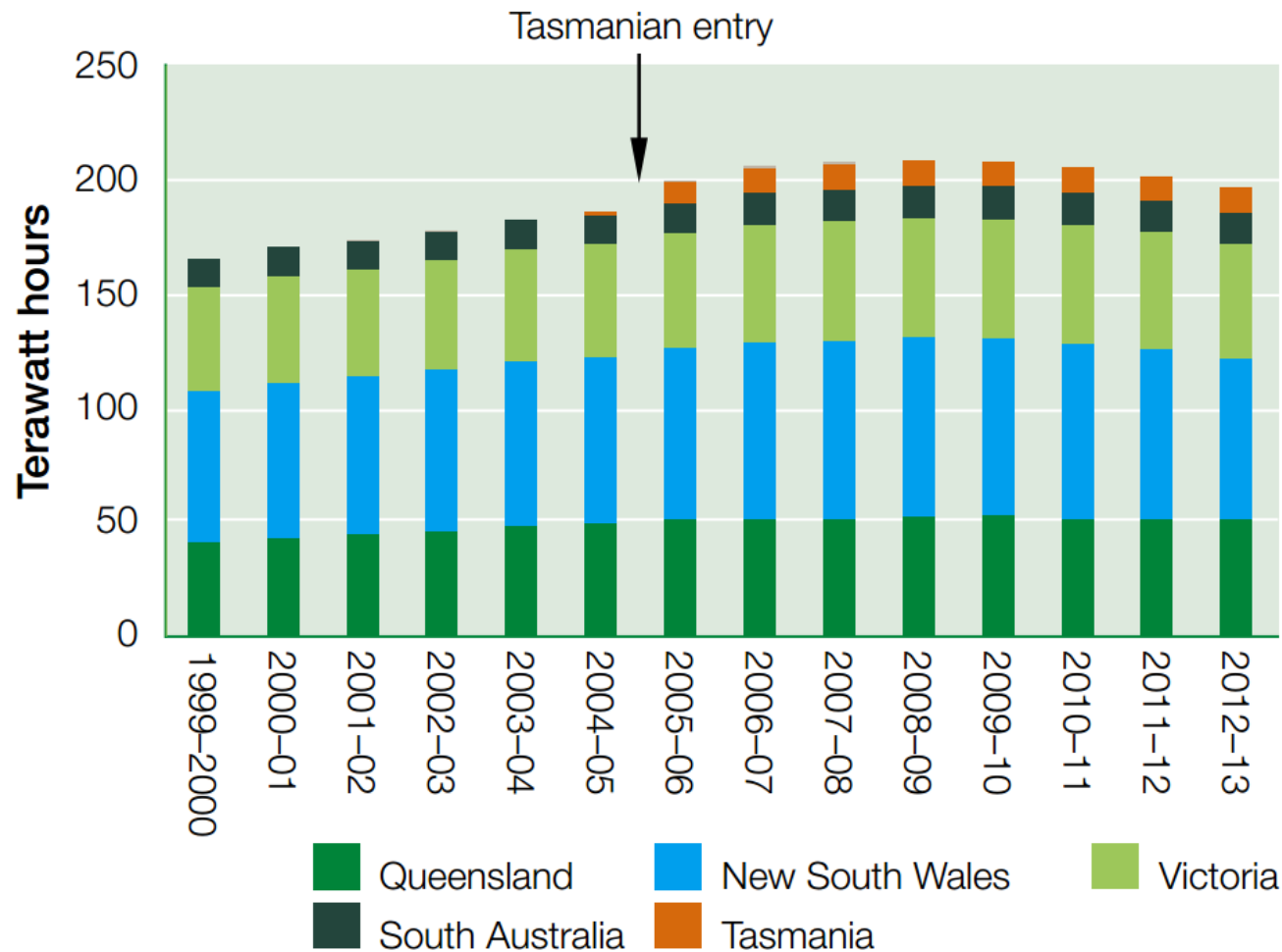


THE NEXT FEW YEARS...



SLIDE 3

DEMAND SUPPLIED BY GRID IS FALLING



Falling demand from grid

- Rooftop PV
- Efficiency standards
- Price responses
- Reduced industrials

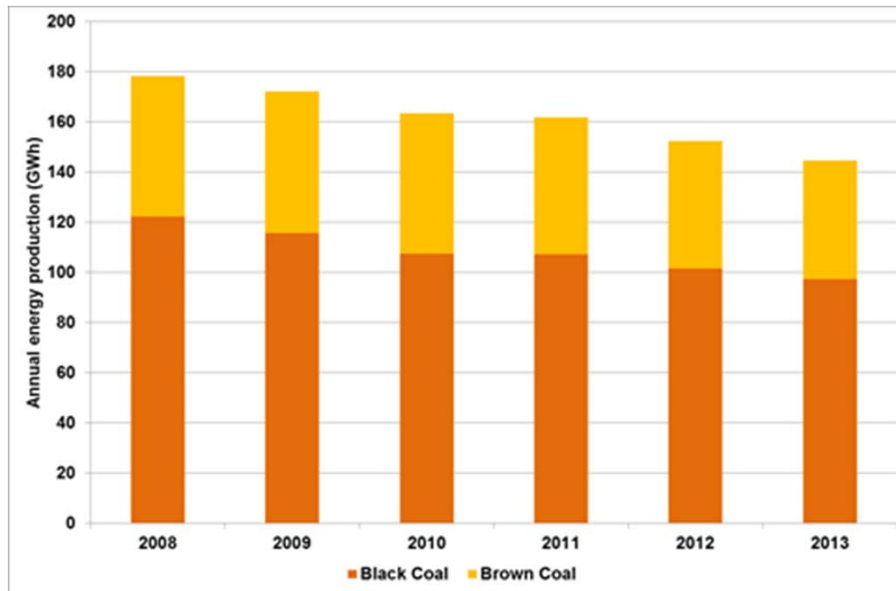
Possible future growth ?

- Electric vehicles
- Fuel substitution

GENERATION MIX IS CHANGING

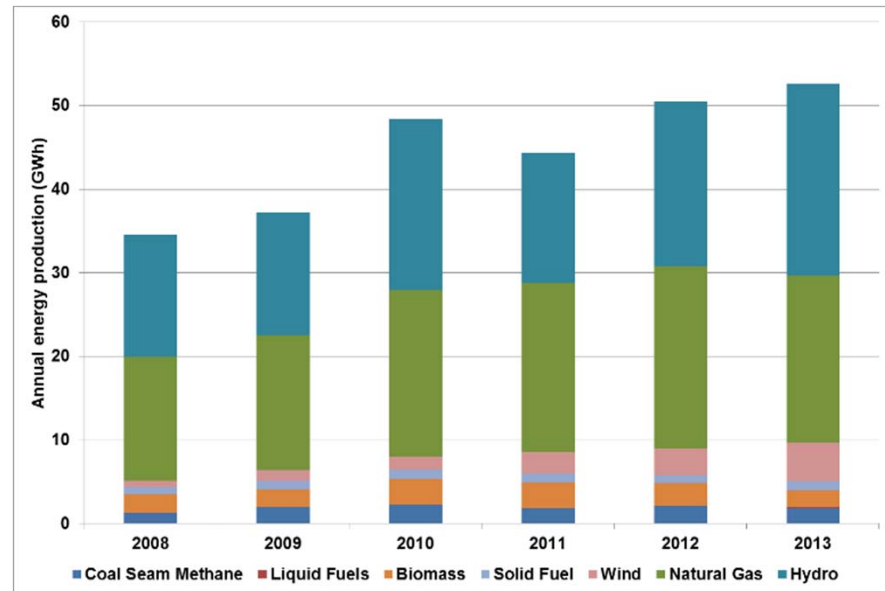


Coal



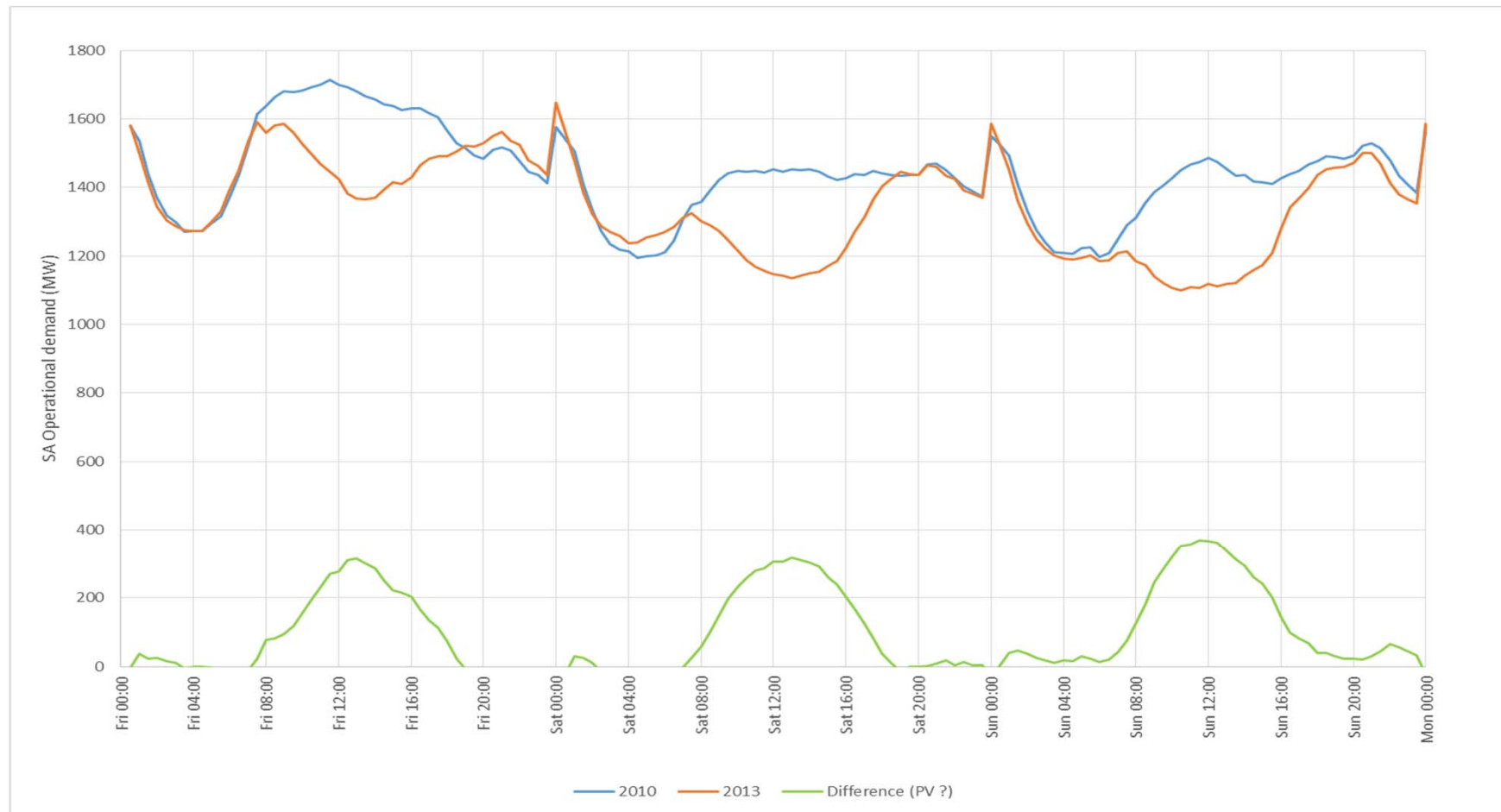
- Coal down ~30 TWh
- Majority from black coal

Hydro / Gas / Renewables



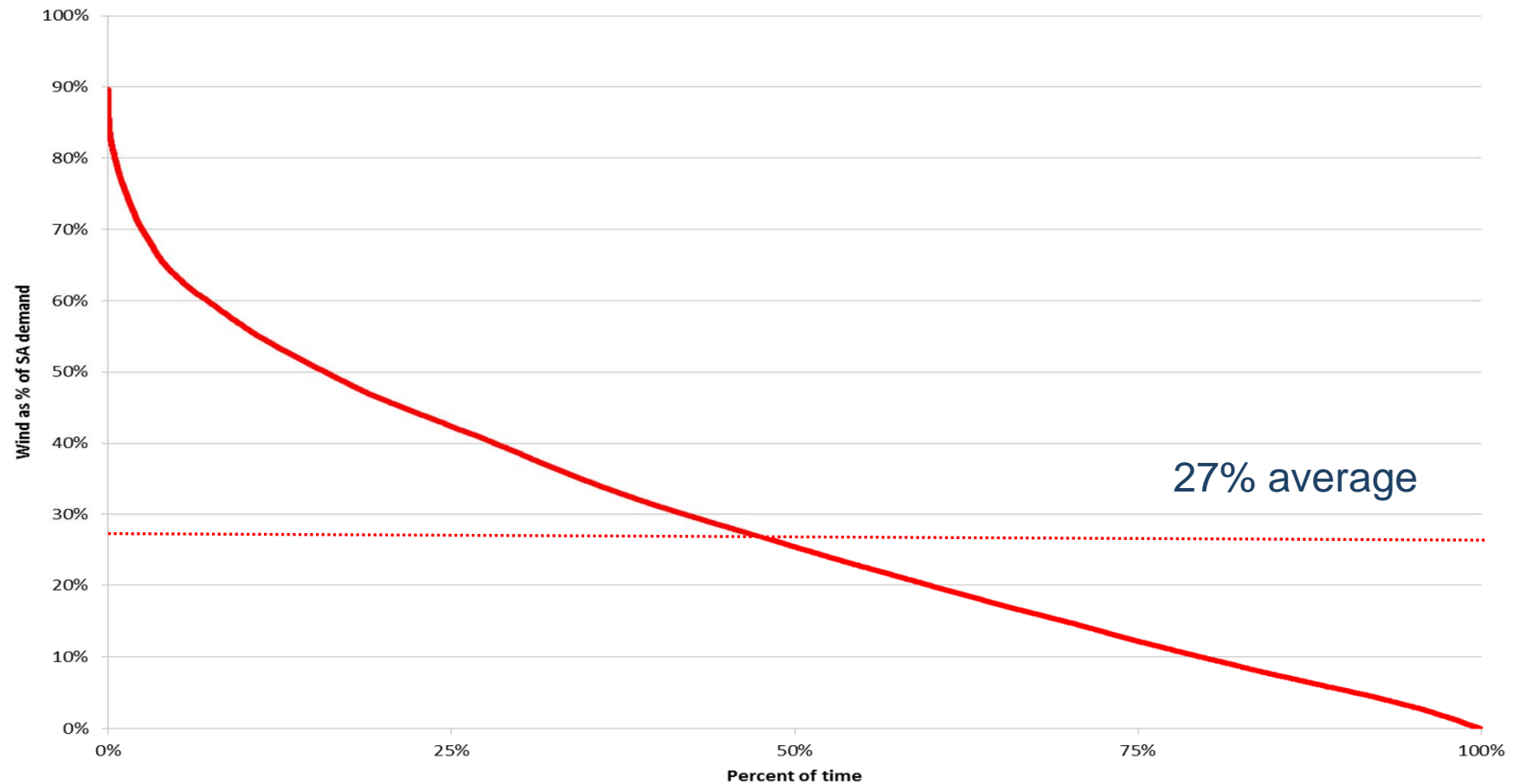
- Hydro variable year-year
- Gas up 5 TWh
- Renewables small, fast growing

EFFECT OF RENEWABLES – PV IN SA



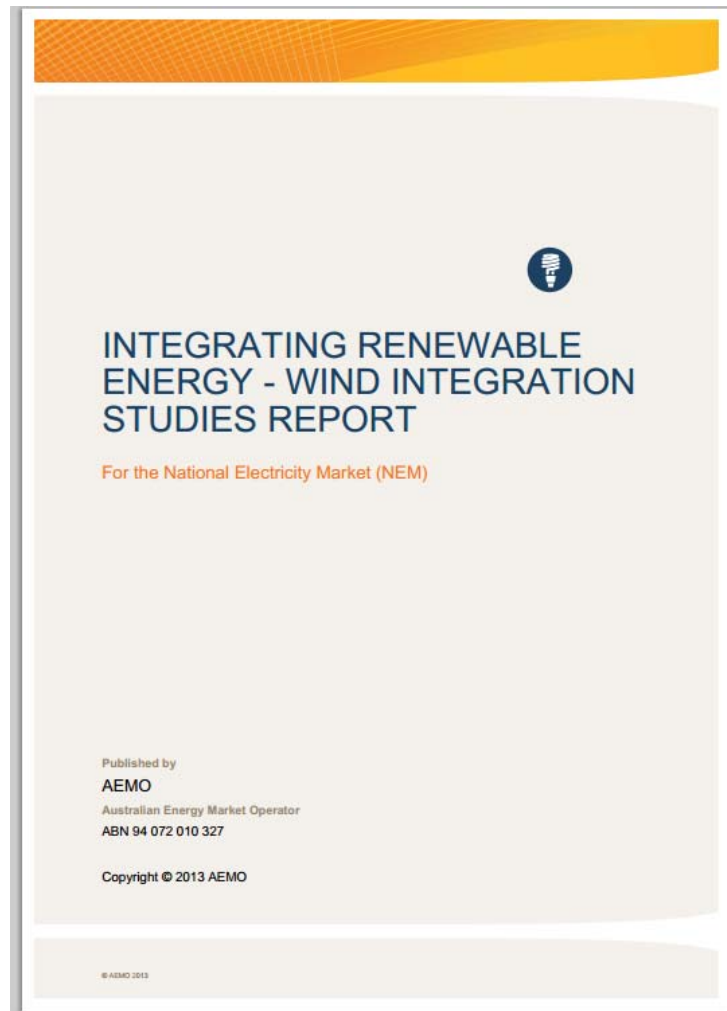
- 2010 vs 2013, same 3 days in December – a forecasting challenge

WIND GENERATION IN SA - 2013



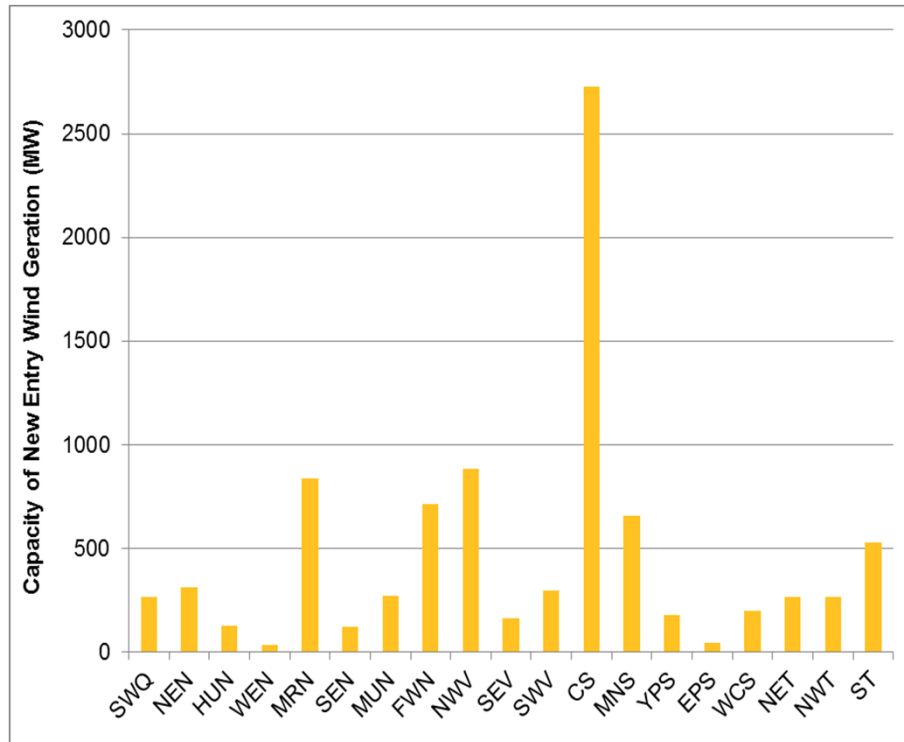
- Operations must cope with rapid change from one extreme to the other

2013 RENEWABLE INTEGRATION STUDY



- 2020 system with 11.5 GW of total wind generation
- What impact on NEM operation ?
 - Interconnector limits
 - Frequency control
 - Fault Levels

8.9 GW NEW WIND GENERATION ADDED



- Majority of new wind planted in SA and VIC
- Power system and market modelling to assess effects



WHAT DID WE FIND ?



- Good operational forecasting vital to renewable integration
 - Grid scale and small scale PV forecasting under development
- Operational challenges come from displacement of conventional generation from the system.
 - Loss of 'services' like inertia, frequency control, fault level
 - Impact on grid stability and frequency control
 - Behaviour of incumbents is important, but hard to predict
- Biggest challenges when renewables form the largest portion of the supply mix.
 - Change from historical focus on maximum demand
- Impacts minimised when installation is geographically spread around the NEM.
 - Best wind resource may not in future be best location.

FREQUENCY CONTROL



- Short term supply / demand balancing and frequency control.
 - Low cost, voluntary market (FCAS), \$25M in 2012
 - No incentive or obligation for renewables to participate.
- Renewables can complicate frequency control:
 - Don't participate themselves, displace the generators who do
- Issues in TAS, and in SA when separated from NEM.
 - Not seen as a problem for mainland NEM.
- Some changes required to frequency control arrangements

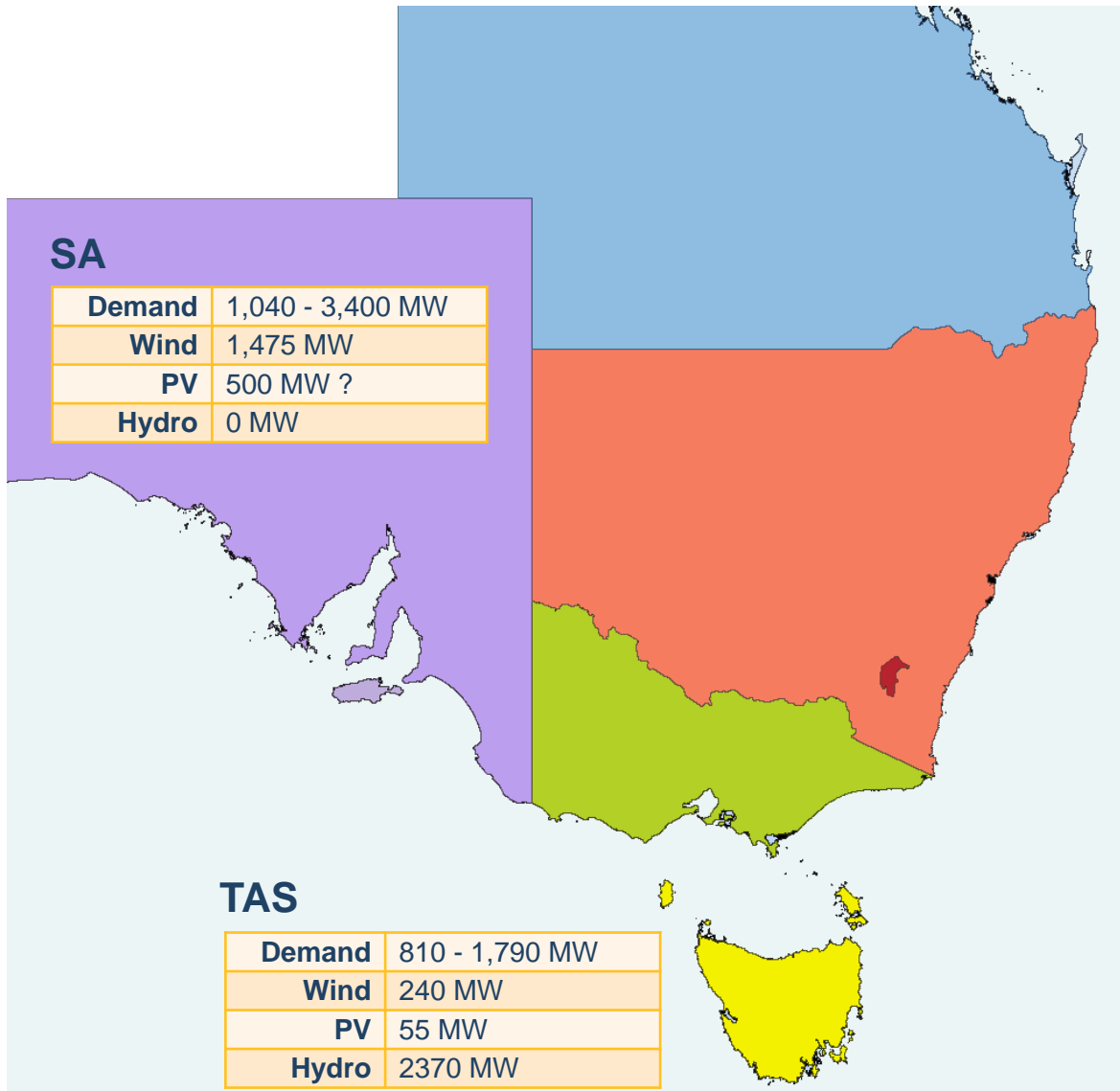
STABILITY AND INTERCONNECTOR LIMITS



- Displacement of conventional generation can reduce grid stability.
 - Affects power transfer between regions.
 - Managed through significant wind curtailment in SA and VIC
 - Up to 35% curtailment in VIC, mainly due to this issue
- Very dependent on response of incumbent generation
 - Do they stay online at reduced load, or come off ?
 - Not all drivers are clear, or easily modelled.
 - Are the right incentives in place ?

- B.A.U. is viable.
 - Significant impact on wind, if expansion occurred as assumed
- Range of other options identified
 - Network investment
 - New markets or incentives
 - Changes to technical standards for new connection
 - Complex questions of cost, market efficiency, market power, technical questions.
 - No preferred new options identified at this time

WHAT NEXT ?



QLD

Demand	4,100 - 8,900 MW
Wind	0 MW
PV	~1,000 MW
Hydro	648 MW

NSW

Demand	5,120 - 14,740 MW
Wind	430 MW
PV	671 MW
Hydro	2342 MW

VIC

Demand	3,780 - 10,490 MW
Wind	1,015 MW
PV	532 MW
Hydro	2187 MW

FOCUS ON OPERATION OF SA



- Challenges unique to SA
 - Highest installed renewables vs demand
 - Typical demand 1.1 - 1.7 GW
 - ~1.5 GW wind by end 2013)
 - ~0.5 GW rooftop PV
 - Relatively inflexible thermal generation fleet
 - At risk of separation from NEM
- Any case for changes likely to emerge in SA
- Is only Wind + PV operationally viable in SA ?
- Operations and renewables one part of larger AEMO work stream

INDUSTRY CHALLENGES



- Changing customer behaviours and response to policy.
 - Diminishing load from the main power system (“at the meter”)
 - Technological change – wind, embedded generation, rooftop PV, smart meters, appliance efficiency, storage ?.
- Changing market paradigm.
 - Reduced network energy but see short duration peak network demand
 - Increasing supply vs flat demand = downwards pressure on wholesale prices, retirements, exit pathways for generators.
 - Shift from centrally scheduled power system/major generation to increasing embedded generation (unscheduled)
- AEMO’s challenges.
 - Power system operation, forecasting, planning in a decentralised world;
 - Retail and wholesale markets suited to the changing environment

Watch this space...

THANK YOU



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